



Technology

Hybrid Cloud Solutions

NetApp
February 11, 2024

This PDF was generated from https://docs.netapp.com/us-en/hybridcloudsolutions/cloud_volumes_service/snapshot_cloud_volumes.html on February 11, 2024. Always check docs.netapp.com for the latest.

Table of Contents

| | |
|------------------------------|----|
| Technology | 1 |
| Cloud Volumes Service | 1 |
| Cloud Volumes ONTAP | 8 |
| NetApp Private Storage | 10 |

Technology

Cloud Volumes Service

Blogs

NetApp Cloud Volumes, Not Your Mothers File Service

Authors: Chad Morgenstern, Karthik Chinnathambi

If you are thinking about your data in the clouds, consider that NetApp Cloud Volumes Service is about more than just NFS or SMB. With the Cloud Volumes Service, you can rest assured that your data is durable, encrypted, and highly available. But what about protection from user errors, wouldn't you love the ability to roll back time to undo choices you may have made and wish you hadn't? Yeah, we got you covered there too with NetApp Cloud Volume Service's Snapshot capability.

Durability, Availability, Encryption and Snapshots

Durability

Your data is protected not just against multiple drive failures, but against numerous type of disk errors that could otherwise affect not just your data durability but your data integrity as well. No more worries that your data is going to disappear.

Encryption

Regarding encryption, NetApp Cloud Volume service utilizes Storage Encryption to provide full-disk encryption without compromising storage application performance. This single-source solution can increase overall compliance with industry and government regulations without compromising your user experience.

Availability

The Cloud Volumes Service is built upon best of industry, proven rock-solid enterprise class hardware and software all but ensuring uptime – availability. Each storage node has many paths to its own Solid State Drives protecting against path failure as well as access to a partner storage node SSDs as well. As each storage node has access to its partners disks, continued productivity in the event of controller failure is ensured. You are protected against network failures by redundant network ports and paths all the way up the stack across the cloud connections.

As NetApp Cloud Volume Service for AWS sits centrally in relation to each of the availability zones within an AWS region, the service is immune to availability zone outages. Access your data from any availability zone without the need to replicate content – the user experience from AZ to AZ is expected to be the same and if not, well, its outside of our control – clouds will be clouds after all.

The Undo Button

Snapshots act as logical backups and are as such point-in-time representations of your data. The creation of Snapshots may be scheduled or taken manually both within the Cloud Volumes Portal.

Volumes

Snapshots

Sync

Support

API documentation

Volume - code (351b2b4c-b8da-5c2b-75b4-f086aecaf13e)

Export path/s: 172.16.50.52/goofy-ebullient-code

Name: code edit

Tags: edit

Volume path: /goofy-ebullient-code

Service level: Basic edit

Created: 24 days ago

Used storage: 0 B

Quota: 322.12 GB edit

Region: us-east

Mount targets

Snapshots

Export policy

Snapshot policy

Sync

Actions

+ Create new snapshot

| <input type="checkbox"/> | Name | Size | Volume | Region | Created ↓ |
|--------------------------|---------------|-------|--------|---------|---------------------|
| <input type="checkbox"/> | snapshot_demo | 100 B | code | us-east | 2018-06-08 12:29:22 |

The Cloud Volume Service is evolving rapidly and as such I can tell you that API support for Snapshot creation is coming.

NetApp Cloud Volume Snapshots are fast, plentiful and non-disruptive. A NetApp Snapshot simply manipulates block pointers, creating a “frozen” read-only view of a volume that lets applications access older versions of files and directory hierarchies without special programming. Because the actual data blocks aren’t copied, Snapshot copies are extremely efficient both in the time needed to create them and in storage space. A Cloud Volume Snapshot copy takes only a few seconds to create—typically less than one second, regardless of the size of the volume or the level of activity within the environment.

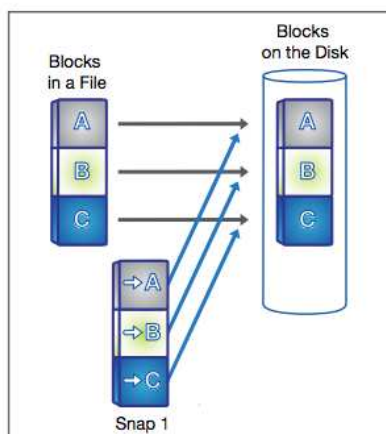


Figure 1a

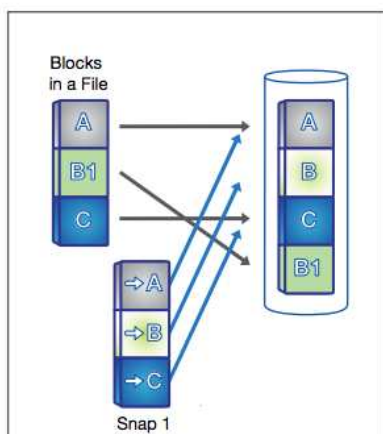


Figure 1b

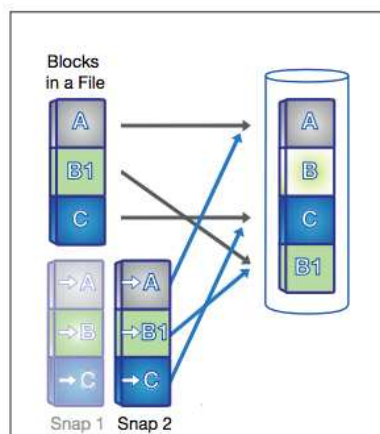
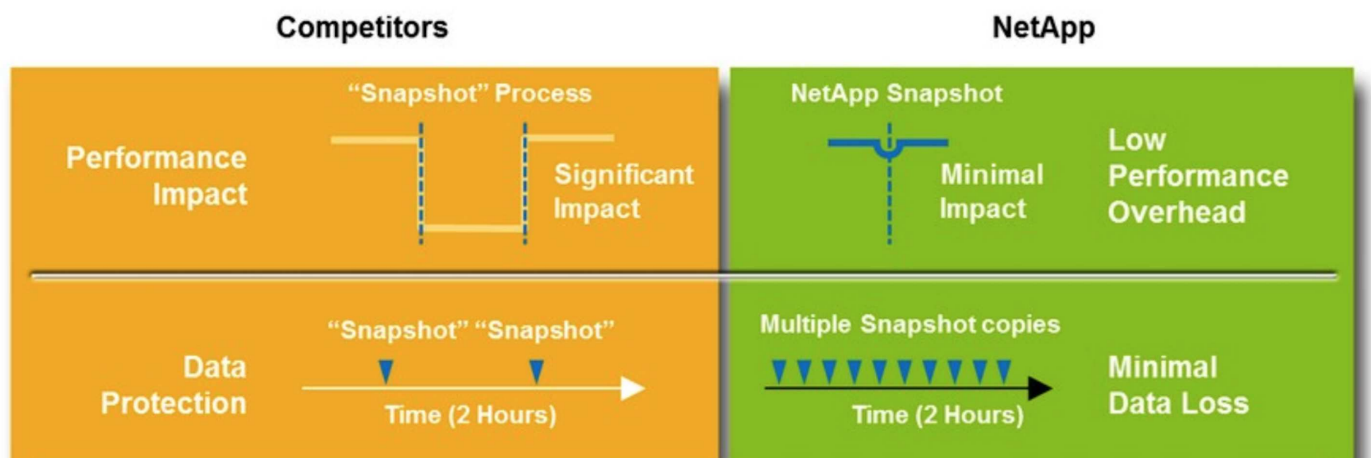


Figure 1c

A snapshot is taken in 1a. In 1b, changed data is written to a new block and the pointer is updated, but the snapshot pointer still points to the old block, giving you a live view of the data and an historical view. Another snapshot is taken in 1c and you now have access to 3 generations of your data without taking up the disk space that 3 unique copies would require; live, snapshot 2 and snapshot 1 in order of age.

A NetApp Cloud Volume Snapshot copy incurs no performance overhead; users can comfortably store up to 255 Snapshot copies per volume, all of which are accessible as read-only and online versions of the data. Read-only via the “.snapshot” directory located at the root of the filesystem and online from a cloned volume today and in-place restore in the near future. So what about user experience when working with the cloned volume? Because of the pointer system, use of the cloned volume should provide a comparable experience to the use of the parent volume itself.



About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of data across cloud and on-premises environments to accelerate digital transformation. We empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize operations. For more information, visit: www.netapp.com #DataDriven

Oracle in the Clouds

NetApp Cloud Volumes Service For AWS

A review of Oracle performance as it pertains to the NetApp Cloud Volumes Service in AWS.

Authors: Ali Aiello, Joe Carter, Chad Morgenstern

If you are thinking about your data in the clouds, consider that the NetApp Cloud Volumes Service is about more than just NFS or SMB. With the NetApp Cloud Volumes Service, you can rest assured that your data is durable, encrypted, highly available and performant.

Please see the blog [NetApp Cloud Volumes, Not Your Mothers File Service](#) for details regarding how NetApp Cloud Volumes approaches durability, encryption, and availability as well as some really nice details regarding the Cloud Volumes snapshot technology.

The remainder of blog focuses on Oracle performance. Oracle is especially well suited for inclusion in the NetApp Cloud Volumes Service. Beyond the fact that your data is protected by 8 nines of durability and is accessible across all the availability zones within a given region, Oracle's Direct NFS client seems almost purpose built for Amazon's AWS architecture. More on that later.

Performance

When performing evaluations of database workloads, always keep in mind the impact of server memory. Ideally queries find their data resident therein as latency from memory is always going to be orders of magnitude lower than any "disk" query. What does this mean for you? While storage latency matters, memory hit percentage matters more. When database administrators say that they need a latency of X, keep in mind what they are talking about.

With that said...

The Oracle Direct NFS client spawns many network sessions to each NetApp Cloud volume, doing so as load

demands. The vast number of network sessions brings the potential for a significant amount of throughput for the database. Far greater than a single network session can provide in AWS.

To test Oracle's ability to generate load, NetApp ran a series of proofs of concept across various EC2 instance types, with various workload mixtures and volume counts. The SLOB2 workload generator drove the workload against a single Oracle 12.2c database. Keep in mind that at present AWS has no support for Oracle RAC, so single node testing was our only option.

The testing showed that the while any instance size is fine - run an instance size according to your need - Oracle and NetApp Cloud Volumes can consume the resources of even the largest instance. Towards that end, the graphics below focus on the c5.18xlarge instance type.

Workload : 100% Update

Amazon AWS imposes an architectural egress limit of 5Gbps for all I/O leaving the VPC. This limit defines the lower threshold in the graphic below, as seen in the 100% update workload represented by the green lines below. This workload amounts to 50% read and 50% write, the writes being the limiting factor. Though the two-volume test resulted in slightly lower application latency compared to the one-volume test, both volume counts converge at the same point the VPC egress limit which worked out to be just around 130,000 Oracle IOPS.

Workload : 100% Read

The 100% read workload represents the upper limit for the Oracle Database running against the NetApp Cloud Volumes Service in AWS. The pure read workload scenario, as shown by the red lines, is limited only by the instance type and the amount of network and CPU resources available to the instance. Just as the 100% update workload discussed above, though the two-volume configuration resulted in lower application latency, the tested configurations converged at the instance resource limit. In this case just shy of 300,000 Oracle IOPS.

Workload : 75% Read 25% Update

The third workload, shown in purple, is a 75% Oracle read and 25% Oracle update or read-modify-write workload. This scenario performed exceptionally well be it with one or two volumes, though the two-volume scenario outperformed the other. Many database administrators prefer the simplicity of a single volume database, 200,000 IOPS ought to satisfy all but the most demanding of database needs and doing so with the simple layout desired by these dba's. For those needing more, additional volumes will enable greater throughput as shown below.

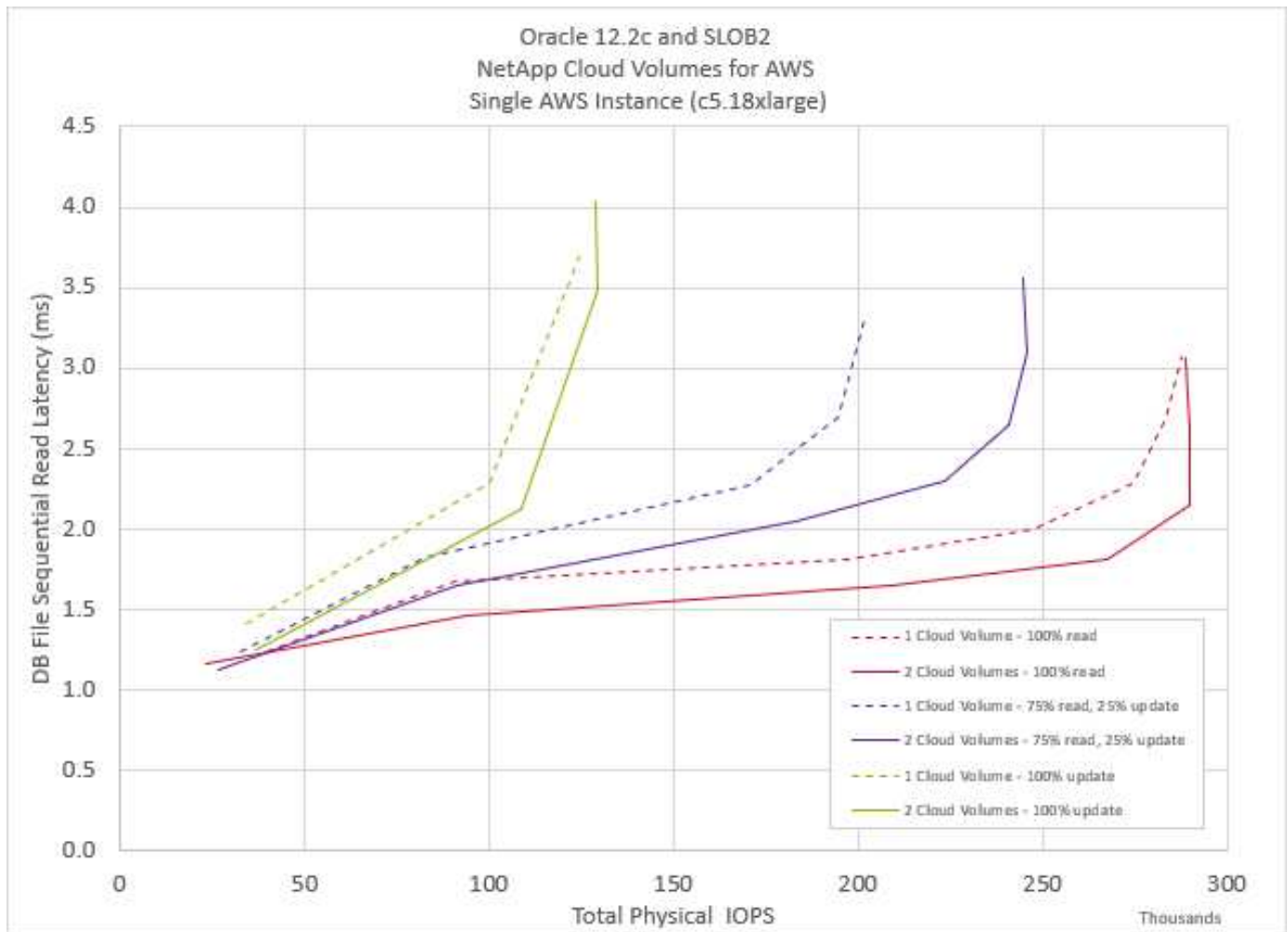


Figure 1. Oracle SLOB Test Graphic

Best Practices

- init.ora file
 - db_file_multiblock_read_count
 - remove this option if present
- Redo block size:
 - Set to either 512 or 4KB, in general leave as default 512, unless recommended otherwise by App or Oracle.
 - If redo rates are greater than 50MBps, consider testing a 4KB block size
- Network considerations
 - Enable TCP timestamps, selective acknowledgement (SACK), and TCP window scaling on hosts
- Slot tables
 - sunrpc.tcp_slot_table_entries = 128
 - sunrpc.tcp_max_slot_table_entries = 65536
- Mount options

| File Type | Mount Options |
|-----------|---------------|
|-----------|---------------|

| | |
|---------------|--|
| ADR_home | rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536 |
| Oracle Home | rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536,nointr |
| Control Files | rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536,nointr |
| Redo Logs | rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536,nointr |
| Datafiles | rw,bg,hard,vers=3,proto=tcp,timeo=600,rsz=65536,wsz=65536,nointr |

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of data across cloud and on-premises environments to accelerate digital transformation. We empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize operations. For more information, visit: www.netapp.com #DataDriven

MySQL in the Clouds

NetApp Cloud Volumes Service For AWS

A review of MySQL performance as it pertains to the NetApp Cloud Volumes Service in AWS.

Authors: Ali Aiello, Chad Morgenstern, Ron Pratt

Are looking for consistently good performance for your MySQL database - I mean, really, who is going to answer no to that question? With or without snapshots, whether you are accessing the primary database or a snapshot copy, you can expect excellent, consistent performance from the NetApp Cloud Volumes Service. Performance is of course not the whole story. Databases need durability, data is a crown jewel of any enterprise. Consumers demand the protection against theft provided by encryption, we've got that too, its managed by the service. Add to these the advantage of accessing database volumes from any availability zone within the region – without the need to replicate to make this possible – and you'll find that the NetApp Cloud Volumes Service is the ideal solution for your MySQL needs.

Please see the blog [NetApp Cloud Volumes, Not Your Mothers File Service](#) for details regarding how NetApp Cloud Volumes approaches durability, encryption, and availability as well as some really nice details regarding the Cloud Volumes snapshot technology.

The remainder of this blog focuses on MySQL performance.

Performance

When performing evaluations of database workloads, always keep in mind the impact of server memory. Ideally queries find their data resident therein as latency from memory is always going to be orders of magnitude lower than any “disk” query. What does this mean for you? While storage latency matters, memory hit percentage matters more. When database administrators say that they need a latency of X, keep in mind what they are talking about.

With that said...

The Workload Generator

To test MySQL with cloud volumes, NetApp used the TPC Benchmark C workload generator. TPCC is an industry standard online transaction processing (OLTP) benchmark that leverages actual MySQL databases and their I/O paths. Workload generators that leverage real applications are always preferred over more synthetic generators such as Vdbench, Iozone, and heaven forbid dd, tar, cpio, or cp. TPCC standardized on an 80/20 read:write workload, the test results in this section are based there on.

The Scenarios

Two scenarios were tested in this environment, the first evaluated the capabilities of a single instance to drive MySQL I/O, while the second set out to determine the edges of a single cloud volume. The results of both scenarios are shown in the graphic below. The gray line represents the single-instance and blue the multi-instance environment. Please note that the latency reported in the graphics below represent storage latency as reported by the database.

The Results

Run against the single instance, TPCC generated approximately 4.5Gbps worth of I/O which approaches the Amazon Web Service inter-VPC limit imposed per network connection. Run against multiple instances, TPCC generated just about 16Gbps of throughput against a single Cloud Volume - which is pretty darned cool.

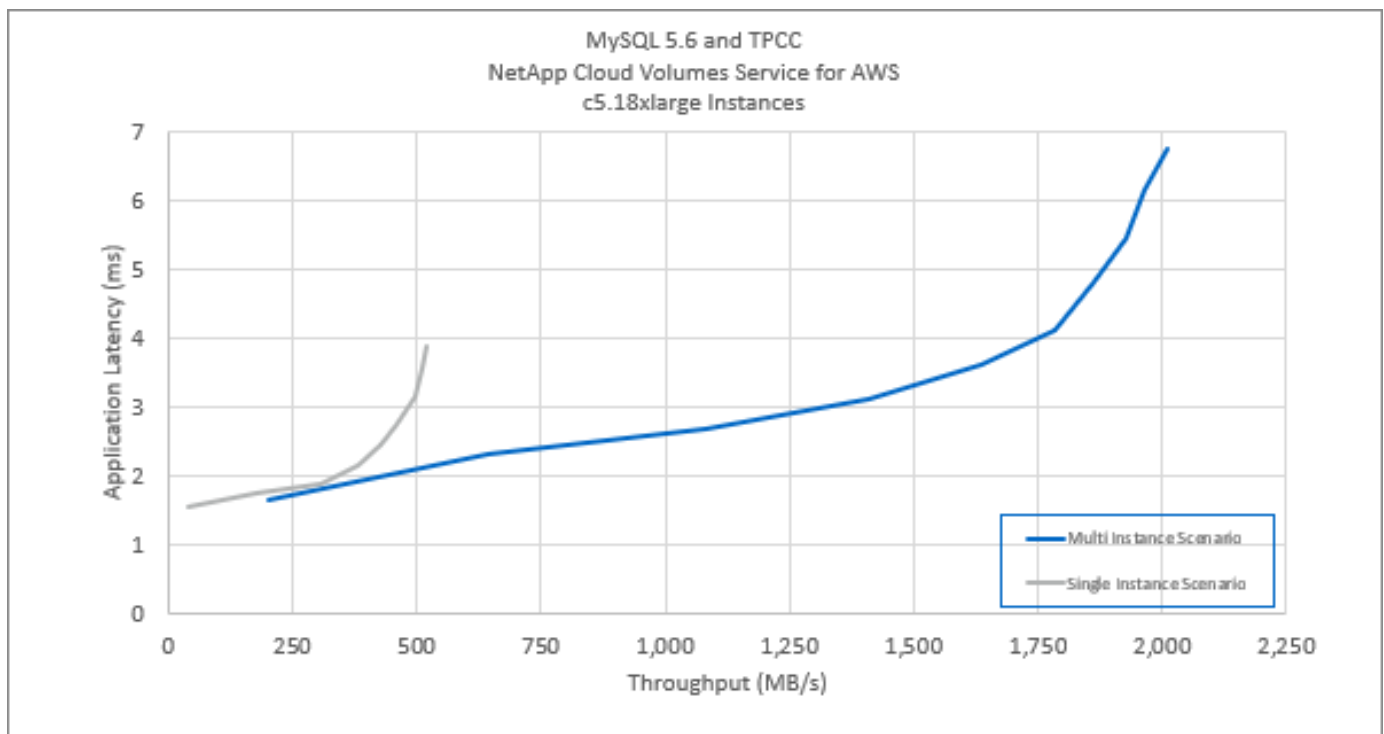


Figure 2. MySQL TPCC Test Graphic

Best Practices

The following parameters were placed in the MySQL `/etc/my.cnf` configuration file.

- [MySQLd]
 - `innodb_buffer_pool_size=23622320128`
 - `innodb_log_buffer_size=4294967295`
 - `innodb_log_file_size=1073741824`

- innodb_flush_log_at_trx_commit=2
- innodb_open_files=4096
- innodb_page_size=4096
- innodb_read_io_threads=64
- innodb_write_io_threads=64
- performance_schema
- innodb_doublewrite=0;
- max_connections=1000
- innodb_thread_concurrency=128
- innodb_max_dirty_pages_pct=0

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of data across cloud and on-premises environments to accelerate digital transformation. NetApp empowers global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize operations. For more information, visit <https://www.netapp.com/#DataDriven>

Cloud Volumes ONTAP

Blogs

NetApp Cloud Volumes ONTAP, A.K.A. ONTAP Cloud

Improved Performance Through Enhanced Networking Support

If you haven't heard the news, NetApp ONTAP Cloud has been rebranded as NetApp Cloud Volumes ONTAP. Along with the change comes exciting news of the release of support for ONTAP 9.4 – which in Amazon brings significant increases in front end performance. How cool is that, for once something really is both “New and Improved.”

The most significant addition to the ONTAP 9.4 release for Cloud Volumes ONTAP is the inclusion of support for enhanced networking for the software defined storage system. As described by Amazon:

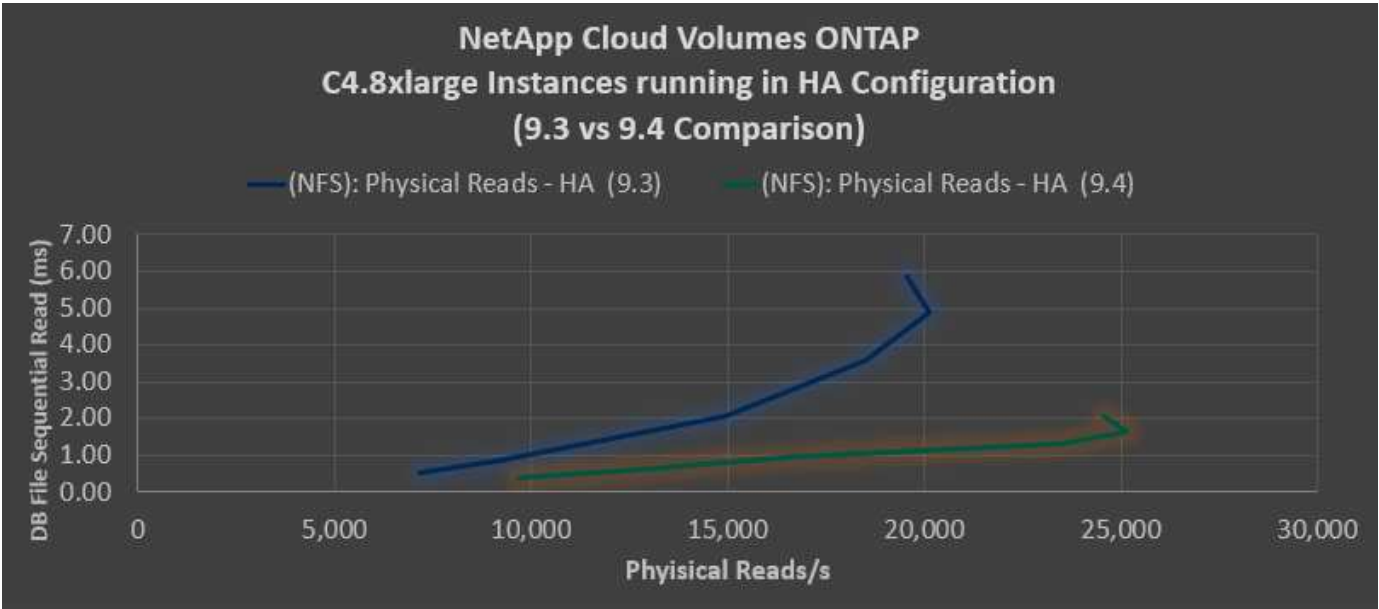
“Enhanced networking uses single root I/O virtualization (SR-IOV) to provide high-performance networking capabilities on [supported instance types](#). SR-IOV is a method of device virtualization that provides higher I/O performance and lower CPU utilization when compared to traditional virtualized network interfaces. Enhanced networking provides higher bandwidth, higher packet per second (PPS) performance, and consistently lower inter-instance latencies. There is no additional charge for using enhanced networking.”

Keep in mind that there are two types of enhanced networking interfaces supported by AWS and that NetApp supports at present the former (VF).

1. Intel 85299 Virtual Function (VF) interface which is supported within Xen hypervisor
2. Elastic network adapter supported from within KVM

The following graph calls out the increase in performance introduced by upgrading from ONTAP 9.3 to ONTAP 9.4 on an active-passive HA pair based on the c4.8xlarge instance type. Using the SLOB2 workload generator and Oracle 12.2c we performed a 75% read 25% update workload using an 8K database block size. While the

read I/O rate increased 25% simply by upgrading an Cloud Volumes ONTAP cluster, the latency reduction is even more impressive.



The upgrade path from ONTAP 9.3 to ONTAP 9.4 is a breeze with OnCommand Cloud Manager (OCCM). OCCM takes care of everything from upgrading the Cloud Volumes ONTAP nodes without downtime (assuming your environment is running in an HA configuration) to enabling sriov-net-support on the instances. Its as simple as clicking on the “New version available link” below and checking yes on a few “I have read and acknowledge the above.”

Cloud Manager

Replication Status

Timeline

Working Environments

Visual View

Tabular View

+ Add Working Environment

AWS

upgrade_pair

US-EAST-1A

HA

< 0.01 TB

Allocated Capacity

upgrade_pair

ONTAP Cloud HA | AWS

AWS Account: 800322537672

Cluster Management IP: 10.11.0.197

Node-1 Serial Number: 90580032253767278512

Node-2 Serial Number: 90580032253767263653

★ New version available

Not all instance types support enhanced networking, OCCM can help you there too by showing which instance types support this enchantment (those with the lightning bolt as shown below) as well as managing the process of instance type change in case you are interested in such. As the upgrade process, instance type change may be performed non-disruptively if running in an HA configuration.

↶ Change License or Instance Type

ONTAP Cloud Premium (Current) ▾

ONTAP Cloud Premium
Flexible performance and expanded capacity for a wider range of applications. Supports up to 368 TB of underlying AWS storage.

Change Instance Type from **r4.2xlarge** to:

☐ m4.4xlarge ⚡

☐ r3.2xlarge

☒ **m4.4xlarge ⚡**

☐ c4.4xlarge ⚡

☐ c4.8xlarge ⚡

About NetApp

NetApp is the data authority for hybrid cloud. We provide a full range of hybrid cloud data services that simplify management of data across cloud and on-premises environments to accelerate digital transformation. We empower global organizations to unleash the full potential of their data to expand customer touchpoints, foster greater innovation and optimize operations. For more information, visit: www.netapp.com #DataDriven

NetApp Private Storage

Blogs

GDPR and Hybrid Cloud: A More Perfect Union



With the European Union's General Data Protection Regulation (GDPR) now in full swing, chances are that some area of your business must rapidly alter how it manages the personal information and data of EU persons. With potential fines of up to 4 percent of global revenue for a GDPR violation, it is behooved of every business to ensure compliance with these regulations. NetApp Hybrid Cloud can provide your company the competitive advantage of accelerating time to market in this highly regulated space.

By leveraging a hybrid cloud solution, organizations mitigate compliance risks associated with GDPR. Businesses may decide to leverage the cloud for less sensitive data all while storing more sensitive data on prem. The NetApp portfolio may be leveraged in several different ways to achieve the desired level of resiliency, cost-savings, and compute capacity while still maintaining compliance. Consider the following two scenarios:

1. On-Prem All Flash FAS (AFF) and Cloud Volumes Service

A NetApp AFF A800 cluster delivers ultra-low latency of below 200 microsecond and massive throughput of up to 300 GB/s powered by a combination of NVMe SSDs and NVMe/FC connectivity. In addition to being able to run your apps with unprecedented speed and scale you can maintain full control of the data on-prem.

NetApp Cloud Volumes offers customers a fully-managed, cloud-native file storage service that integrates with on-prem AFF system via NetApp CloudSync. This means you can offload less secure data into the cloud seamlessly. Furthermore, if you have archival regulation requiring long term retention, you may choose to move content to an even lower, long-term storage tier reducing cost and maintaining even the most stringent record-keeping requirements.

2. NetApp Private Storage (NPS) for Cloud

Each NetApp Private Storage for Cloud solution consists of a NetApp AFF storage system. The NPS systems are collocated in an Equinix data center and are directly connected with a service provider's cloud compute using a dedicated, high-bandwidth, low-latency network connection. Leverage the scalability of cloud compute while honoring data privacy, regulatory, and sovereignty requirements. NPS for Cloud is based on the NetApp ONTAP® storage operating system, offering a common storage management framework, or data fabric, with your on-premises data center. Using a single known operating system, you secure your regulated data on-prem and your less stringent data in the cloud.

The flexibility built into the NetApp portfolio enables customers to meet GDPR requirements without compromising on cost, speed or resiliency. Deploy as your needs demand.

Copyright information

Copyright © 2024 NetApp, Inc. All Rights Reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP “AS IS” AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

LIMITED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (b)(3) of the Rights in Technical Data -Noncommercial Items at DFARS 252.227-7013 (FEB 2014) and FAR 52.227-19 (DEC 2007).

Data contained herein pertains to a commercial product and/or commercial service (as defined in FAR 2.101) and is proprietary to NetApp, Inc. All NetApp technical data and computer software provided under this Agreement is commercial in nature and developed solely at private expense. The U.S. Government has a non-exclusive, non-transferrable, nonsublicensable, worldwide, limited irrevocable license to use the Data only in connection with and in support of the U.S. Government contract under which the Data was delivered. Except as provided herein, the Data may not be used, disclosed, reproduced, modified, performed, or displayed without the prior written approval of NetApp, Inc. United States Government license rights for the Department of Defense are limited to those rights identified in DFARS clause 252.227-7015(b) (FEB 2014).

Trademark information

NETAPP, the NETAPP logo, and the marks listed at <http://www.netapp.com/TM> are trademarks of NetApp, Inc. Other company and product names may be trademarks of their respective owners.